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Anorogenic Gross Spitzkoppe granite stock in central western Namibia: Part I. Petrology and geochemistry

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ABSTRACT

The Gross Spitzkoppe is a small (~30 km^2) anorogenic granite stock that was emplaced into the Damara Orogenic Belt of central western Namibia in response to mantle plume activity and early Cretaceous rifting of western Gondwanaland.

The epizonal Gross Spitzkoppe stock (GSS), penecontemporaneous mafic and felsic dikes in the country rocks, and synplutonic mafic dikes and mafic magmatic inclusions within the GSS indicate bimodal magmatism. The GSS consists of three zonally arranged granitic units: medium-grained biotite granite at the margins, coarse-grained biotite granite, and porphyritic granite at the center of the stock. Late-stage silicic dikes and pegmatites cut the granites of the stock. All the granites are mildly peraluminous, topaz-bearing, high-silica monzogranites that contain extremely Fe-rich biotite (siderophyllite-annite) as the only primary mafic silicate. Common accessory minerals include: topaz, fluorite, magnetite, zircon, monazite, thorite, ilmenite, columbite, and niobian rutile. Miarolitic cavities and pegmatite pockets within the stock suggest that fluid saturation was attained.

Rectilinear structures of biotite-rich schlieren along the marginal parts of the stock suggest that magma flow was parallel to the walls of the chamber, whereas turbulent or plume-like flows are indicated by curved, circular, and ladder-dike schlieren. Geochemical variation among the granites can be attributed to fractional crystallization of major and accessory minerals and by accumulation of halogen complexes with rare-earth and high-field-strength elements. The negative, partially irregular, correlation between whole-rock contents of F and Cl suggests that Cl was partially lost to a vapor phase during magmatic degassing. The granites of the Gross Spitzkoppe show clear A-type and within-plate granite characteristics, corresponding to the actual tectonic setting. The granites are interpreted to have formed by partial crustal remelting related to mafic underplating in a continental rift environment.